



Original communication

Blood alcohol concentration of suicide victims by partial hanging



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ABSTRACT

During the investigated period, 2000–2007, 4249 suicides were reported in Slovenia, and 1061 autopsies of suicide deaths from the central, northwestern, and southwestern parts of Slovenia were conducted at the Institute of Forensic Medicine in Ljubljana. To identify a possible role of alcohol use in the selection of suicide method blood samples were collected during medicolegal autopsies of suicide victims in order to establish their blood alcohol concentration (BAC) level at the time of death. The study group consisted of 844 suicide victims that used violent suicide methods and 174 suicide victims that used non-violent suicide methods. Out of the group with violent suicide methods 184 (21.8%) suicide victims by partial hanging and 112 (13.3%) suicide victims by complete hanging were identified. The average age was higher in the group of suicide victims by partial hanging than in the group of suicide victims by complete hanging ($p < 0.001$; $T = 3653$; $df = 294$). The mean BAC was higher ($T = 1.604$; $df = 278$; $p < 0.05$) in the group of suicide victims by partial hanging (0.57 g/kg; $SD \pm 0.92$) than in the group of suicide victims by complete hanging (0.40 g/kg; $SD \pm 0.82$). The proportion of BAC positive suicide victims with blood alcohol concentration above 0.1 g/kg at the time of death was higher in the group of suicide victims who used non-violent suicide methods in comparison to the group of suicide victims who used violent suicide methods ($p < 0.001$; $\chi^2 = 14.988$, $df = 1$). Partial hanging was almost twice as common as complete hanging. Higher BAC in the group of suicide victims by partial hanging and more BAC positive suicide victims in the group who died by non-violent suicide methods could give indications about the role of alcohol in the selection of suicide method.

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1. Introduction

Suicide is a well-documented public health problem throughout the world¹ and so too are alcohol misuse and alcohol dependence.² Hanging is universally available and predominant suicide method in many countries worldwide.^{3,4} The manner of death by hanging is constriction of the neck structures when the force applied by ligature is delivered from gravitational drag of victim's body weight^{5,6} and may result from either complete or incomplete suspension of the

body.^{7,8} In cases of partial hanging the suicide victims are found not fully suspended but in touch with part of their body with floor or other object. Around 50% of suicides by hanging are incomplete.^{7,9} A careful analysis of the circumstances and investigation of the death scene are required before commenting on the manner of death in a case of hanging. It has been reported that the incidence of true partial hangings may be much lower than that reported in the literature because apparent partial hanging has been proposed in some cases.⁸ Injury to the tissues of the neck has been reported more commonly with complete suspension of the body than with partial suspension.¹⁰ The classical external signs of asphyxial death (congestion of the face and petechial haemorrhages) were reported to be more common in cases of partial suspension than in cases of complete suspension.¹¹ While the mechanism of death in the majority of cases

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of partial suspension was reported to be due to airways or vascular obstruction, death in cases of complete suspension appeared to result from, in addition to obstruction (airways or vascular), vagal stimulation or carotid sinus pressure, or a combination of these.¹¹

Studies on suicide and alcohol at the individual and aggregated level confirm the link between alcohol and suicide.¹² The relationship between per capita alcohol consumption and country suicide rate has been described.^{13,14} Acute use of alcohol before accomplished suicide has been established in between 10.0 and 74.6% of cases of completed suicide.^{12,15–21} A clear relationship between alcohol ingestion and younger age has been shown in hanging suicides.²² Acute alcohol consumption and alcohol dependence are known to be associated with increased risk for suicidal behaviour and with selection of more lethal suicide methods,²³ such as hanging, which is the most frequent method in Slovenia,²⁴ a country with high suicidal rate and per capita alcohol consumption.²⁵ However, the influence of blood alcohol concentration (BAC) on the selection of suicide method is poorly understood.

Besides evaluation of the proportion of partial hanging among all suicide hangings, the aim of this retrospective study was to analyse the BAC and demographic characteristics of suicide victims with partial hanging in comparison to the group of suicide victims with complete hanging.

2. Material and methods

2.1. Subjects

All cases of deaths from suicide autopsied at the Institute of Forensic Medicine in Ljubljana from January 2000 through December 2007 were included in the study. During the investigated period, 2000–2007, 4249 suicides were reported in Slovenia, and 1061 autopsies of suicidal deaths from the central, north-western, and south-western parts of Slovenia were conducted at the aforementioned institution. Suicide victims were subdivided into two groups regarding suicide method. Altogether 844 suicide victims who used violent suicide methods and 174 suicide victims who used non-violent suicide methods were included in the study. As described previously,²⁶ violent suicide methods included hanging, drowning, jumping, wrist-cutting, standing in front of high velocity objects; whereas non-violent suicide methods included overdose with psychoactive substances, gas poisoning, and ingestion of a toxic agent. Forty three suicide victims with combined suicide methods or unavailable data about BAC were excluded from further analysis. To further evaluate suicide by hanging, which is the most often used violent suicide method in the Slovenian population, suicide victims who died by hanging were further divided into those that died by partial and to those that died by complete hanging. Partial hanging was defined as hanging where at the time of death the body was in touch with the floor or with objects below supporting the body.

2.2. Materials and instrumental methods

Blood samples from the femoral vein were collected by forensic pathologists during medicolegal autopsies of suicide victims in

order to establish their BAC levels at the time of death. BAC was measured using the head-space gas chromatography method (HSS-GC-FID) and expressed in grams per kilogram (g/kg). Containers filled as full as possible were immediately preserved at 4 °C to prevent postmortem ethanol production.²⁷

Alcohol concentrations in the body fluids were assayed using two routine independent HSS-GC-FID methods in parallel, according to the Institute's routine laboratory protocol. In the first chromatographic procedure, the J&W HP-B ALC capillary column was used on Agilent Technologies G1888 headspace sampler coupled with Agilent Technologies 6890N GC with flame ionisation detection. The second procedure used 2.0 m × 2 mm packed columns filled with Carboxen C stationary phase on Agilent 7694 headspace sampler, coupled with Hewlett Packard 6890 series GC with flame ionisation detection. Throughout the whole observed period BAC was measured in a high proportion of all autopsied suicidal deaths (1018/1061, 96%). It is known that small amounts of alcohol can be produced in the body after death. Therefore, BAC levels of ≥ 0.1 g/kg at the time of death were denoted as BAC positive, in order to draw a distinction between suicide victims who had taken alcohol before accomplished suicide and suicide victims who had not taken alcohol before accomplished suicide.

Permission to perform the study was obtained from the Slovenian Medical Ethics Committee.

2.3. Statistical analysis

BAC of BAC positive suicide victims with violent and non-violent suicide methods were compared. Furthermore, BAC of BAC positive suicide victims with partial and complete hanging were compared. The collected data were processed using Excel Microsoft 2003 and SPSS (Statistical Package for Social Sciences; Chicago, IL, USA) for Windows, Version 15.0.

3. Results

The characteristics of the included suicide victims by violent and non-violent suicide methods are shown in Table 1. Differences were observed between the groups regarding gender distribution ($p < 0.05$; $\chi^2 = 4.047$; $df = 1$). More male suicide victims were observed in the group who had used violent suicide methods than in the group who had used non-violent suicide method. A significant difference in the number of BAC positive suicide victims during the investigated periods was observed between the group of suicide victims who used violent suicide methods and the group of victims who used non-violent suicide methods ($p < 0.001$; $\chi^2 = 14.988$, $df = 1$). The proportion of suicides in which blood alcohol was detected (≥ 0.1 g/kg) at the time of death was 50.3% for the group of suicide victims who used non-violent suicide methods in comparison to 34.4% of suicide victims who used violent suicide methods. For the whole investigated period BACs among all suicide victims ranged from 0.1 to 5.94 g/kg. However, no differences in BAC levels were observed between BAC positive suicide victims who used violent (mean BAC = 0.29 g/kg; $SD \pm 0.92$) or non-violent (mean BAC = 0.21; $SD \pm 0.82$) suicide methods ($p > 0.05$).

Table 1

The number, mean age, gender, and distribution of suicide victims regarding BAC at the time of suicide for the group of suicide victims who used violent suicide methods and for the group of suicide victims who used non-violent suicide method.

Group	Suicide victims		Gender		Blood alcohol concentration	
	Number of cases (%)	Mean age (\pm SD)	Female <i>n</i> (%)	Male <i>n</i> (%)	<0.1 g/kg <i>n</i> (%)	≥ 0.1 g/kg <i>n</i> (%)
Violent	844 (83)	49.28 (\pm 17.79)	214 (25.4)	630 (74.6)	509 (65.6)	267 (34.4)
Non-violent	174 (17)	47.34 (\pm 18.37)	57 (32.8)	117 (67.2)*	84 (49.7)	85 (50.3)**

* $p < 0.05$, $\chi^2 = 4.047$, $df = 1$; ** $p < 0.001$, $\chi^2 = 14.988$, $df = 1$.

Table 2
The number, mean age, gender, and distribution of suicide victims regarding BAC at the time of suicide for the group of suicide victims who used complete hanging and for the group of suicide victims who used partial hanging.

Hanging	Suicide victims		Gender		Blood alcohol concentration	
	Number of cases (%)	Mean age (\pm SD)	Female n (%)	Male n (%)	<0.1 g/kg n (%)	\geq 0.1 g/kg n (%)
Complete	112 (38)	45.4 (\pm 15.88)	32 (28.6)	80 (71.4)	70 (66.0)	36 (34.0)
Partial	184 (62)	52.5* (\pm 17.58)	42 (22.8)	142 (77.1)	102 (57.6)	75 (42.4)

* $p < 0.001$, $T = 3653$, $df = 294$.

Out of the group with violent suicide methods 112 (13.3%) suicide victims by complete hanging and 184 (21.8%) suicide victims by partial hanging were identified. The characteristics of the included suicide victims who used complete hanging and partial hanging are shown in Table 2. The average age was higher in the group of suicide victims who used partial hanging than in the group of suicide victims who used complete hanging ($p < 0.001$; $T = 3653$; $df = 294$). On average suicide victims who used complete hanging were around 7 years younger than suicide victims who used partial hanging. Differences in gender distribution or alcohol presence in the blood between the group of suicide victims who used complete hanging and the group of suicide victims who used partial hanging were not observed ($p > 0.05$).

However, mean BAC was higher in the group of suicide victims who used partial hanging (0.57 g/kg; $SD \pm 0.92$) than in the group of suicide victims who used complete hanging (0.40 g/kg; $SD \pm 0.82$). The difference in BAC between these groups was statistically significant (Fig. 1).

4. Discussion

The present study is the first study focussing specifically on partial hanging. As in some material previously reported, partial hanging is also almost twice as common as complete hanging in our series.^{7,8} We observed that BAC was higher in the group of suicide victims who used partial hanging (0.57 g/kg; $SD \pm 0.92$) than in the group of suicide victims who used complete hanging (0.40 g/kg; $SD \pm 0.82$). However, suicide victims with complete hanging were around 7 years younger than suicide victims who used partial hanging. It could be speculated that higher BAC and age could be associated together in partial hanging. Motor functions might decline with older age and increased BAC influencing the decision about what suicidal method to choose. Differences in gender distribution or alcohol presence in the blood between the group of suicide victims with complete hanging and the group of suicide

victims with partial hanging were not observed in the present study; hence they do not seem to influence the decision of which type of hanging method to choose.

In the present study, no differences in mean BAC levels were observed between BAC positive suicide victims with violent or non-violent suicide methods. According to previous observations,²⁸ the proportion of suicide victims with blood alcohol concentration above 0.1 g/kg at the time of death was higher in the group of suicide victims who used non-violent suicide methods in comparison to the group of patients who used violent suicide methods. The same speculation could be suggested that more motor demanding violent suicide methods were not associated with alcohol presence in the blood of suicide victims and could give indications about the role of alcohol in the selection of suicide method. Other explanations are also possible, such as involvement of alcohol in decision making. Acute alcohol use may be regarded as a disinhibiting agent who has a role in increasing suicide risk by intensifying aggressive behaviour,^{29,30} and propelling suicidal ideation into action.²⁹ According to these observations, it should be expected that suicide victims with violent suicide methods will be BAC positive more often than suicide victims with non-violent methods. Indeed, some reports have indicated that alcohol is associated with violent suicidal methods.^{29,31,32} Further, alcohol by itself could be used in combination with other substances as a suicide method. Indeed, overdose is the most common non-violent suicide method.²⁸ Beside the disinhibiting effect of alcohol in lower doses, heavy drinking could also trigger episodes of depression,^{29,30} and interrupt social ties³³ to further increase risk of suicidal behaviour.

Furthermore, more male suicide victims were observed in the group with violent suicide methods than in the group with non-violent suicide methods. These results are in accordance with previous reports and support the idea that violent suicide methods are more commonly associated with male suicide.^{16,17,28,32,34–37} Further, this study confirms previous observations^{38–40} that alcohol consumption is a common precursor to suicide as the proportion of suicide victims with blood alcohol higher than ≥ 0.1 g/kg at the time of death was 50.3% for the group with non-violent suicide methods in comparison to 34.4% of suicide victims who used violent suicide methods.

There is a final consideration to make; the assumption in the above discussion is that the findings indicate a choice made by the victims between two forms of hanging; 'complete' and 'partial'. For making such a choice, it needs to be assumed that the victims are aware of the difference between these two forms of suicide, but common knowledge among the general public from media, etc is more likely to be that to hang, one must be suspended by the neck with one's feet above the ground. Hence one must ask whether such a choice is always a real one, and therefore, whether at least some cases of partial hanging are not due to a choice by the victim but due to a less efficient though of course, equally effective attempt by the victim to hang himself, in which case, both increasing age and high alcohol concentration could play a part in the outcome.

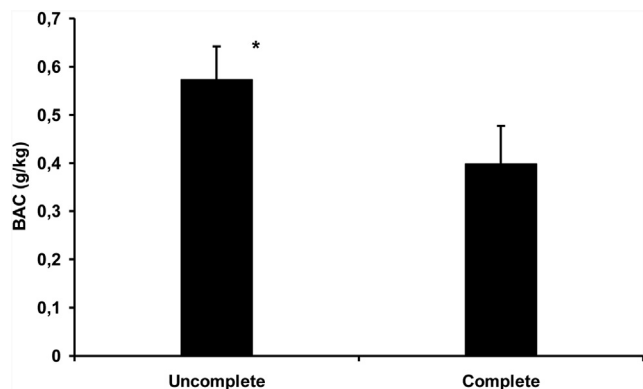


Fig. 1. Blood alcohol concentration of suicide victims by partial hanging. Mean values and standard deviations of blood alcohol concentrations in BAC positive suicide who used complete and partial hanging (* $p < 0.05$, $df = 278$, $T = 1.604$).

5. Conclusions

Partial hanging is almost twice as common as complete hanging. Higher BAC in the group of suicide victims who used partial hanging and more BAC positive suicide victims in the group who used non-violent suicide methods could indicate a role of alcohol in the selection of suicide method. Other explanations are also possible such as motor functions being diminished by alcohol, decreased intention to die associated with higher BAC, increased possibility to be rescued or increased age of suicide victims associated with partial hanging. It is also necessary to question whether the victims actually always make a choice as to which form of hanging to use. If this is not the case, then alcohol and increasing age may cause a less efficient attempt, which then presents as a 'partial hanging'.

Ethical approval

Permission to perform the study was obtained from the Slovenian Medical Ethics Committee.

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Conflict of interest

None.

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